Technical English 1

Lecturer: Nguyễn Xuân Viên, Ph.D

Chapter 1: Compressors

- **OBJECTIVES**
- After studying this unit, you should be able to:
- explain the function of the compressor in a refrigeration system.
- discuss compression ratio.
- describe four different methods of compression.
- state specific conditions under which a compressor is expected to operate.
- explain the difference between a hermetic compressor and a semihermetic compressor.
- describe the various working parts of reciprocating and rotary compressors.

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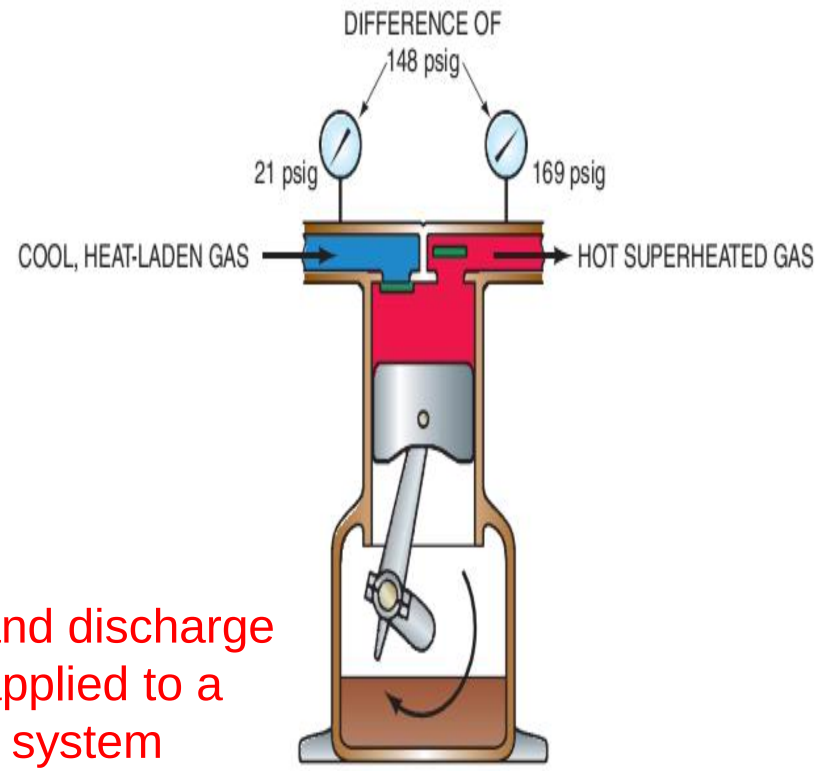
❖ THE FUNCTION OF THE COMPRESSOR

- **The compressor is considered the heart of the refrigeration system**

Cool refrigerant passes through the suction valve of the compressor to fill the cylinders. This cool vapor contains the heat absorbed in the evaporator. The compressor pumps this heat-laden vapor to the condenser so that it can be ejected from the system. The vapor leaving the compressor can be very warm. With a discharge pressure of 169 psig, the discharge line at the compressor could easily be 200°F or higher.



A combination of suction and discharge pressure. This is R-12 applied to a medium-temperature system

Chapter 1: Compressors

- **TYPES OF COMPRESSORS**
- Five major types of compressors are used in the refrigeration and air-conditioning industry. These are the reciprocating, screw, rotary, scroll, and centrifugal compressor.

Figure 23.5 A reciprocating compressor. Courtesy Copeland Corporation

The reciprocating compressor, Figure 23.5, is used most frequently in small- and medium-sized commercial refrigeration systems and will be described in detail in this unit.

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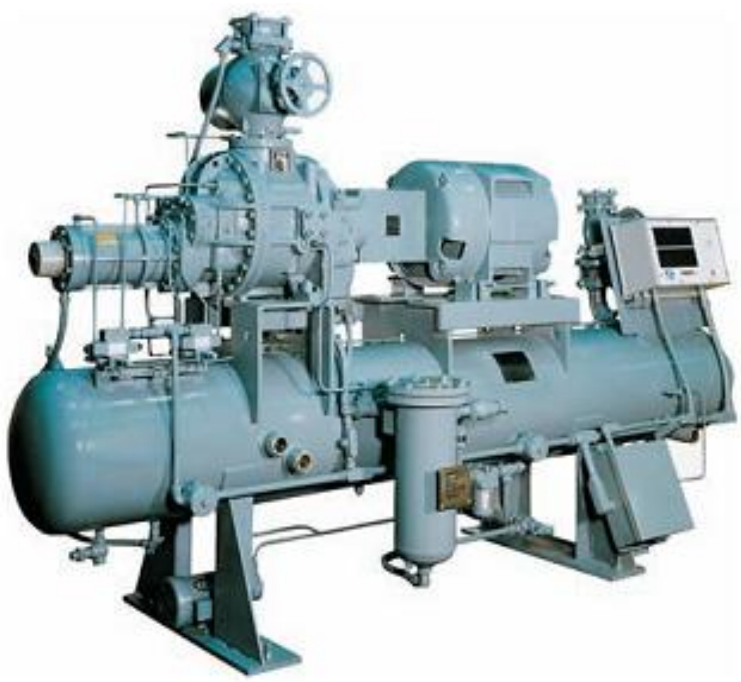

Figure 23.6 A screw compressor. Courtesy Frick Company

The screw compressor, Figure 23.6, is used in large commercial and industrial systems.

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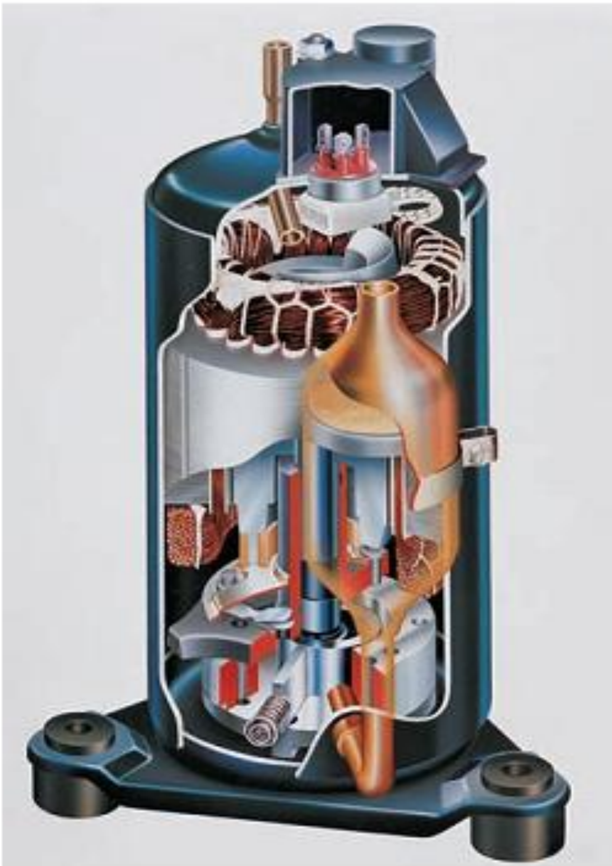

Figure 23.7 A rotary compressor.
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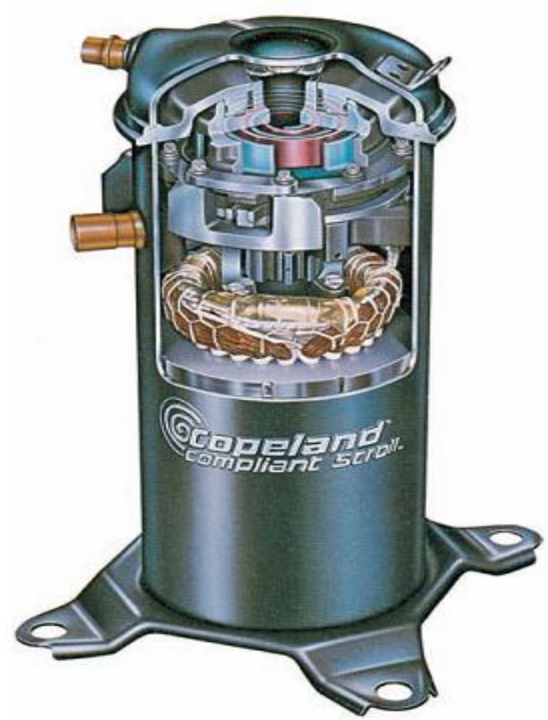

Figure 23.8 A scroll compressor. Courtesy Copeland Corporation

The rotary, Figure 23.7, and the scroll, Figure 23.8, along with the reciprocating compressor, are used in residential and light commercial air-conditioning.

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Figure 23.9 A centrifugal compressor. Courtesy York International Corp.

Centrifugal compressors, Figure 23.9, are used extensively for air-conditioning in large buildings

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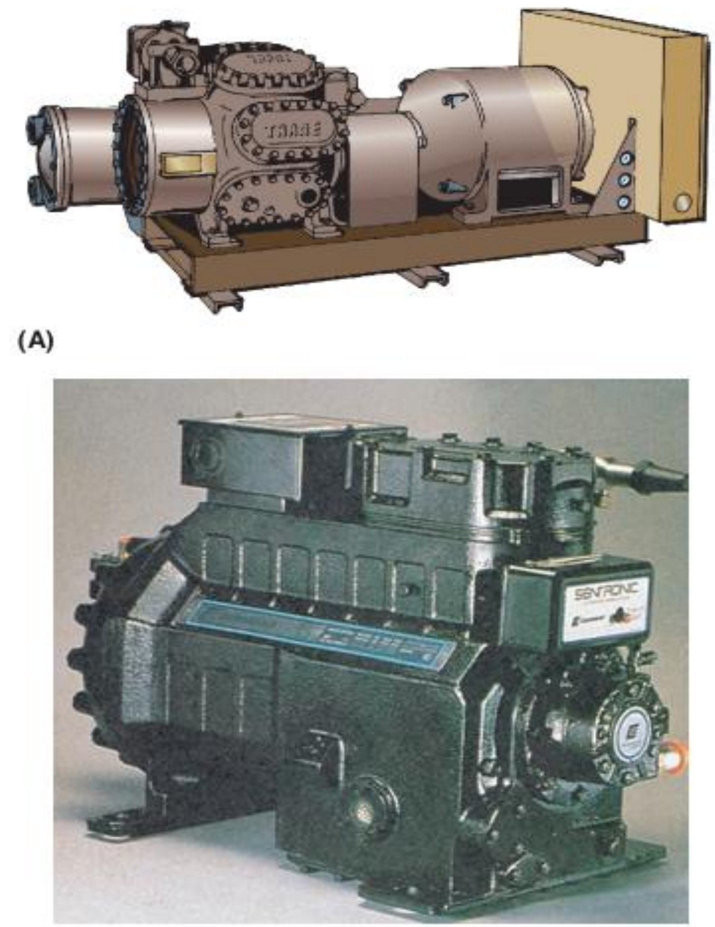
Chapter 1: Compressors

The Reciprocating Compressor

Reciprocating compressors are categorized by their housing and by their drive mechanisms. The two housings are openand hermetic, Figure 23.10. “Hermetic” refers to the type of housing that contains the compressor and is either fully welded,

Figure 23.11, or serviceable or semihermetic, Figure 23.10(B). The drive mechanisms may be either inside the shell or outside the shell. A hermetic compressor has a direct-drive mechanism. The same shaft drives the compressor and motor inside the compressor shell.



(A)

(B)

Figure 23.10 (A) An open-drive compressor. (B) A serviceable hermetic compressor. (A) Courtesy Trane Company 2000. (B) Courtesy Copeland Corporation

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Figure 23.11 The welded hermetic compressor is typical of smaller compressors, from fractional horsepower to about 50 hp. In most welded hermetic compressors, the suction line is usually piped directly into the shell and is open to the crankcase. The discharge line is normally piped from the compressor inside the shell to the outside of the shell. The compressor shell is typically thought of as a low-side component. Courtesy Bristol Compressors, Inc.

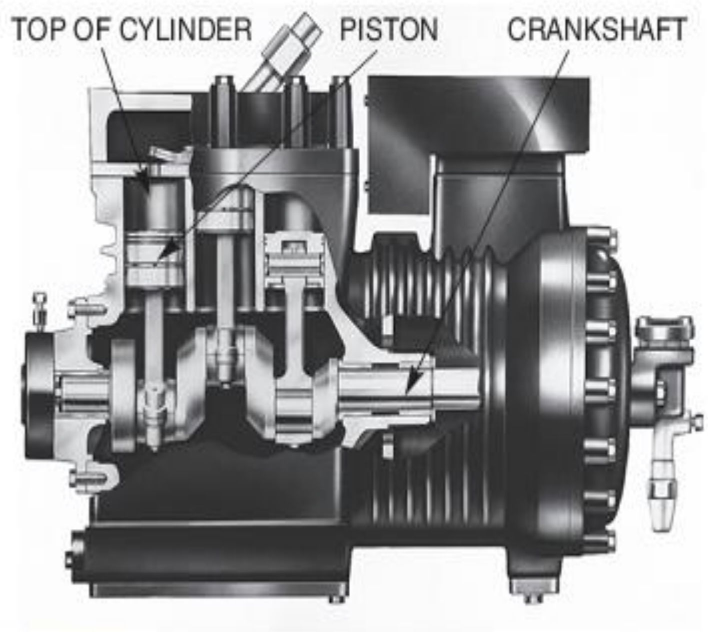

Figure 23.14 The working parts of a serviceable hermetic compressor. The crankshaft is in the horizontal position, and the rods and pistons move in and out from the center of the shaft. The oil pump is on the end of the shaft and draws the oil from the crankcase at the bottom of the compressor. Courtesy Copeland Corporation

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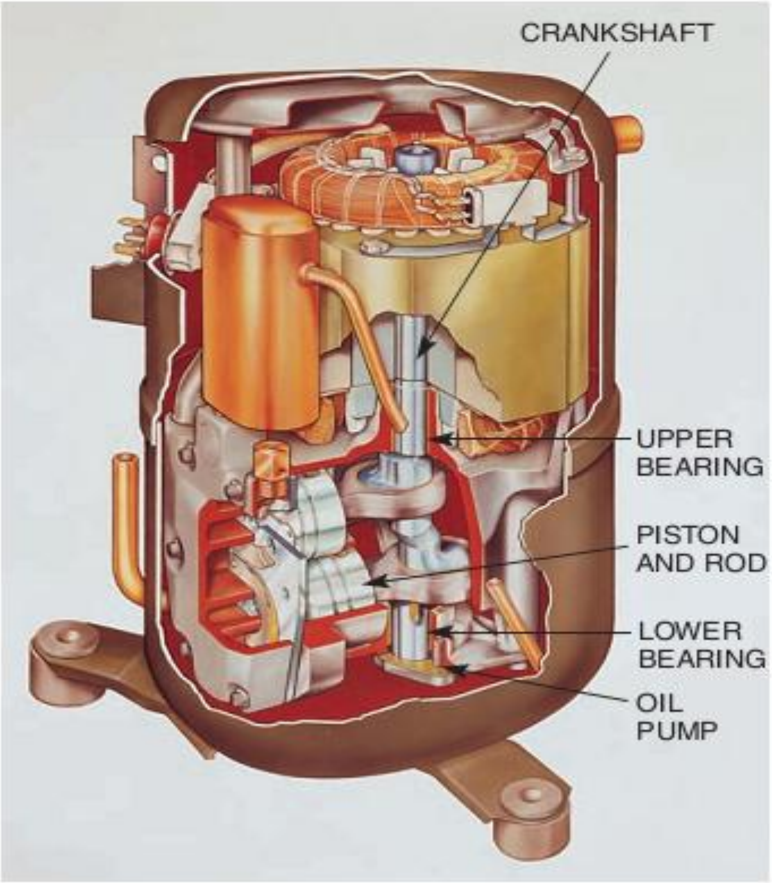

Figure 23.12 The internal workings of a welded hermetic compressor.
Courtesy Tecumseh Products Company

Figure 23.13 A serviceable hermetic (semihermetic) compressor designed in such a manner that it can be serviced in the field.
Courtesy Copeland Corporation

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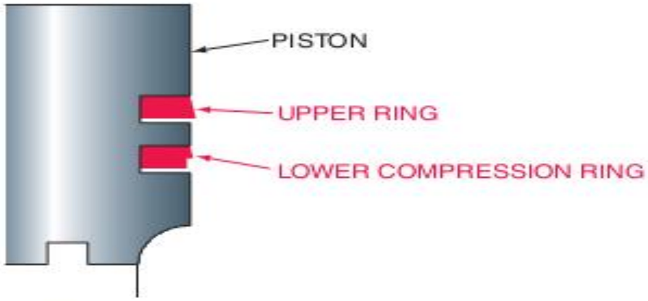
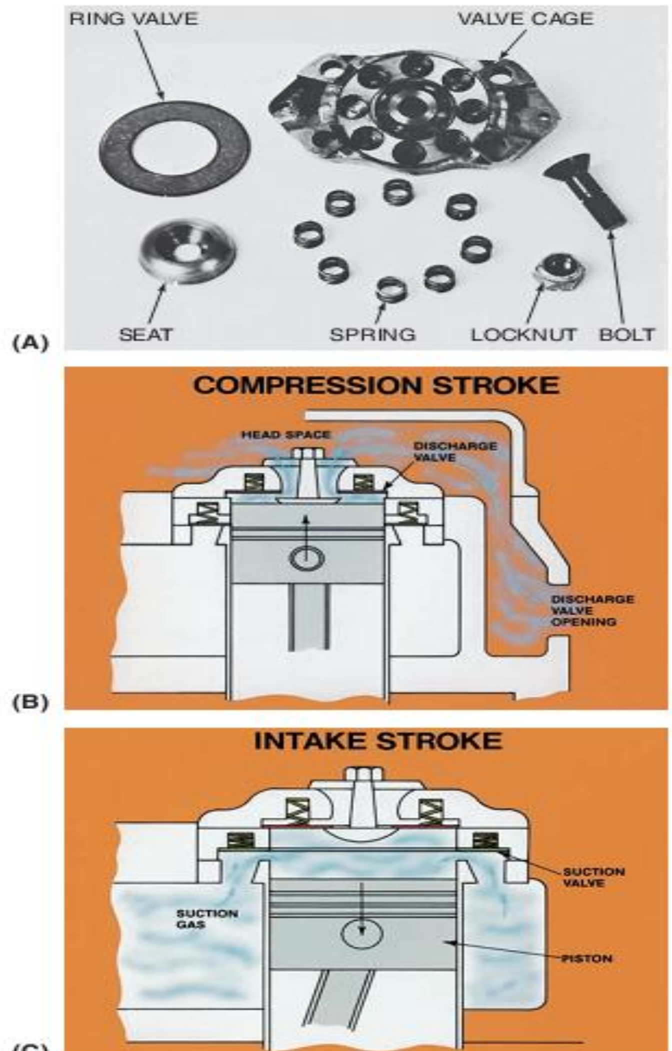


Figure 23.26 The piston rings for a refrigeration compressor resemble the rings used on automobile pistons. Courtesy Trane Company 2000



Chapter 1: Compressors

RECIPROCATING COMPRESSOR EFFICIENCY

A compressor's efficiency is determined by its design. Efficiency starts with the filling of the cylinder. The following sequence of events takes place inside a reciprocating compressor during the pumping action. Our example for the pumping sequence is a medium-temperature applica-tion with R-12 refrigerant, a suction pressure of 20 psig, and a discharge pressure of 180 psig.

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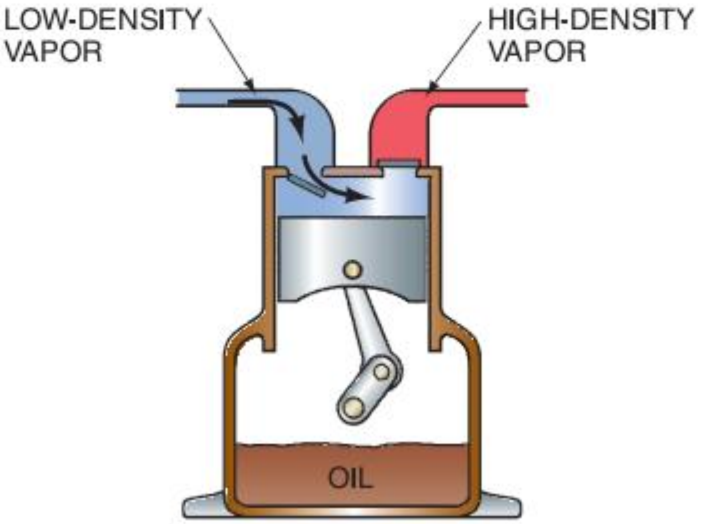
1. Piston at the top of the stroke and starting down. When the piston has moved down far enough to create less pressure in the cylinder than is in the suction line, the intake flapper valve will open and the cylinder will start to fill with gas, Figure 23.42.



PISTON STARTS DOWN

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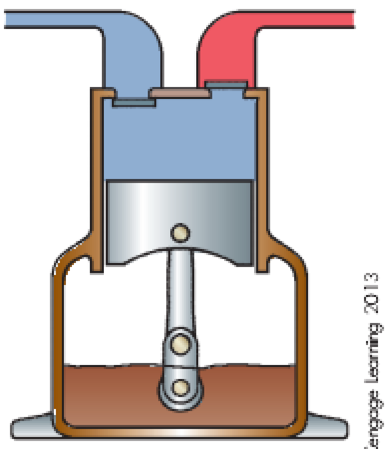
2. Piston continues to the bottom of the stroke. At this point the cylinder is nearly as full as it is going to get. There is a very slight time lag at the bottom of the stroke as the crankshaft carries the rod around the bottom of the stroke, Figure 23.43.



BOTTOM DEAD-CENTER

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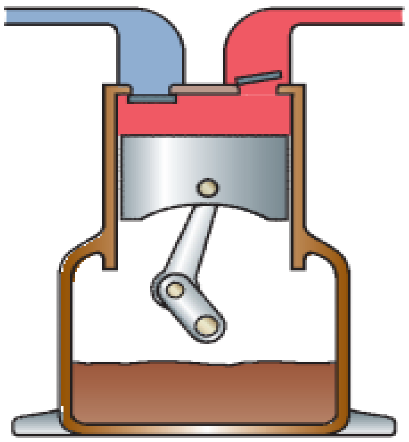
3. **Piston is starting up.** The rod throw is past bottom dead center, and the piston starts up. When the cylinder is as full as it is going to get, the suction flapper valve closes.
4. **The piston proceeds to the top of the stroke.** When the piston reaches a point that is nearly at the top, the pressure in the cylinder becomes greater than the pressure in the discharge line. If the discharge pressure is 180 psig, the pressure inside the cylinder may have to reach 190 psig to overcome the discharge valve's weight and spring tension, **Figure 23.44.**



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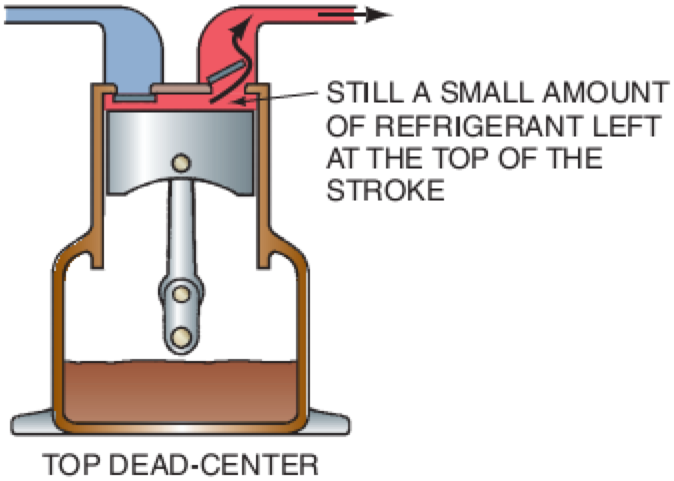
The piston is at exactly top dead center.The piston is as close to the top of the head as it can go. There has to be a certain amount of clearance in the valve assemblies and between the piston and the head, or they would touch. This clearance is known as clear-ance volume



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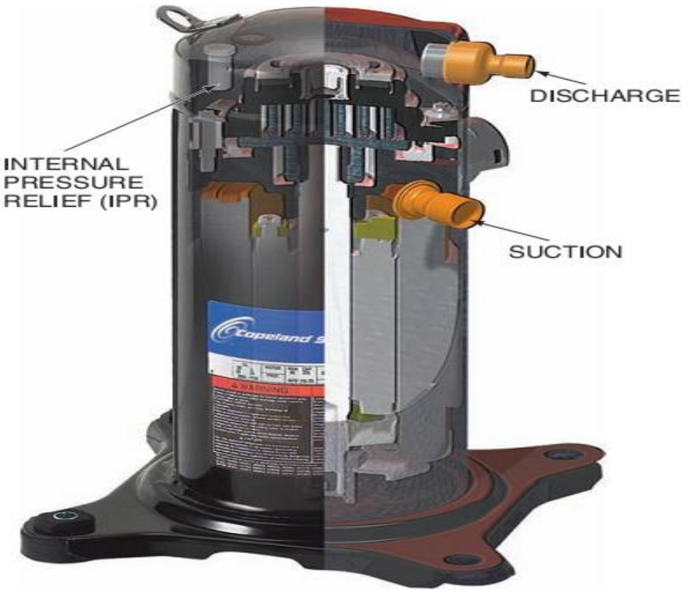
The Scroll Compressor



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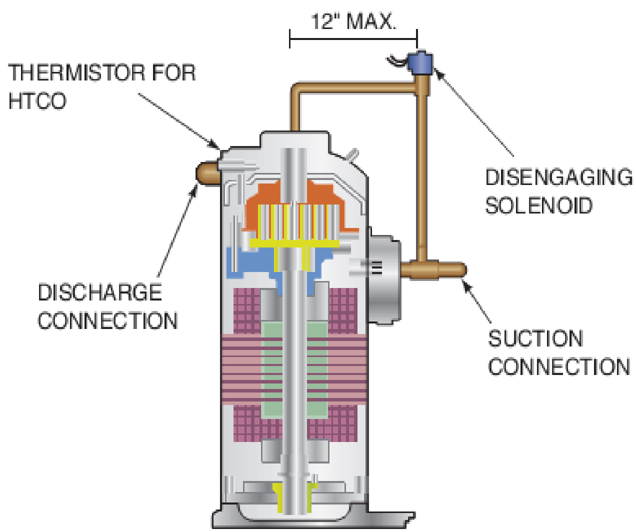
The Scroll Compressor



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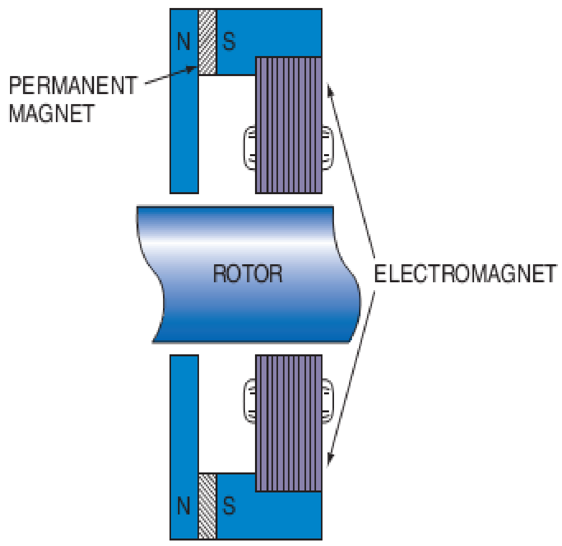
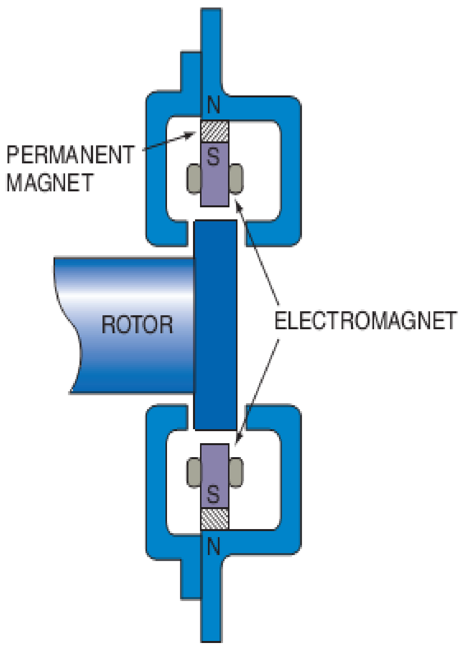
Centrifugal Compressor

MAGNETIC BEARINGS LEVITATE THE ROTOR SHAFT



CROSS SECTION OF RADIAL BEARING



CROSS SECTION OF AXIAL BEARING

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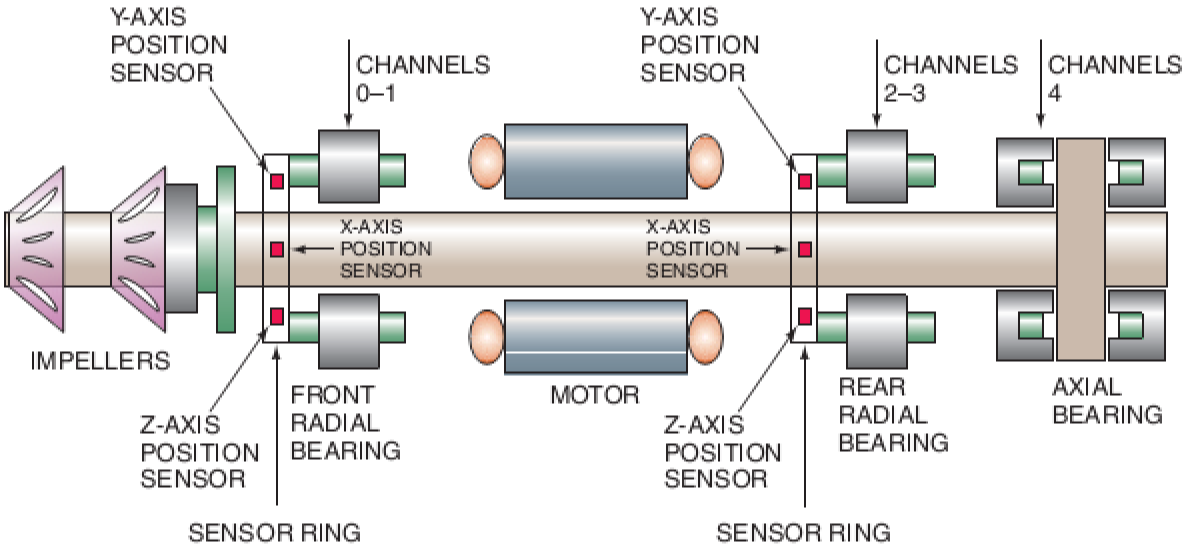


Chapter 1: EXPANSION DEVICES

Expansion Devices

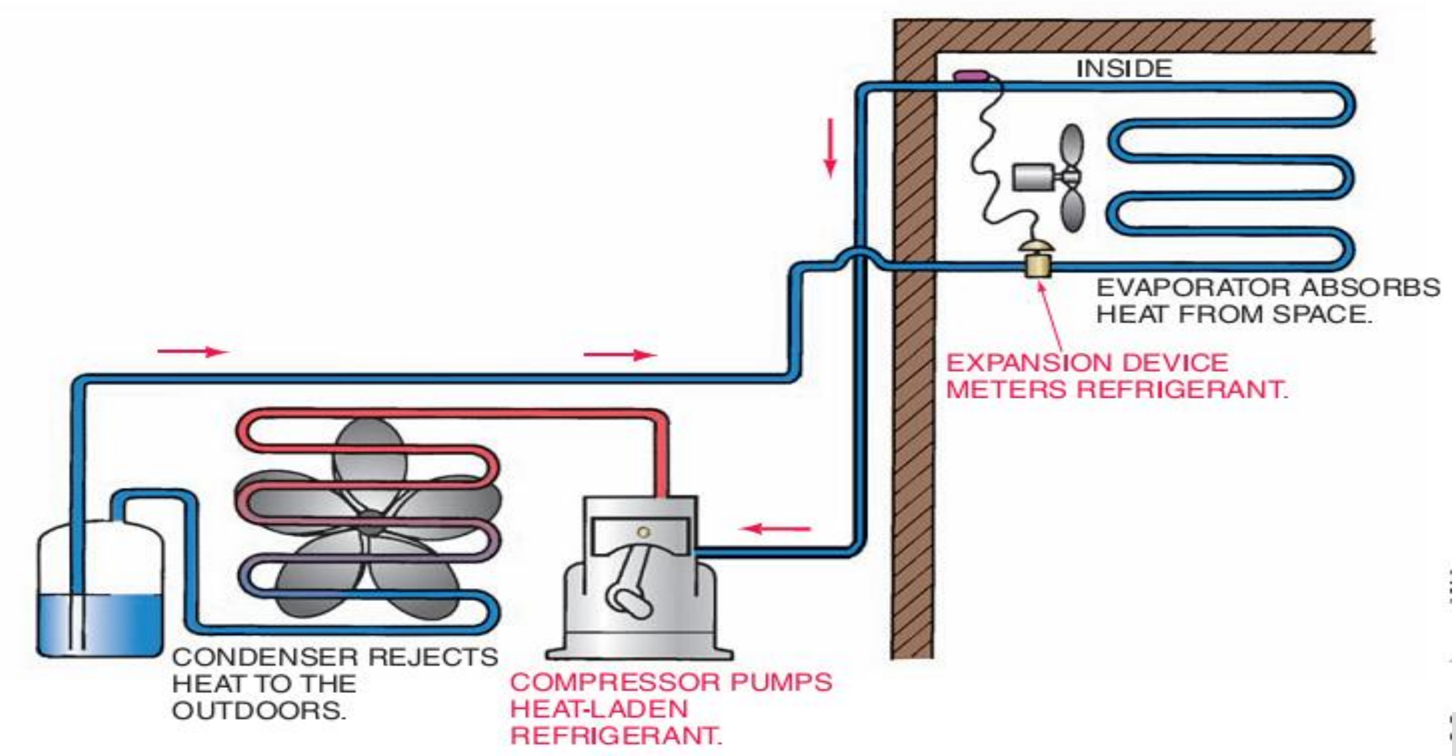
OBJEC TIVES

After studying this unit, you should be able to

- describe the three most popular types of expansion devices.
- describe the operating characteristics of the three most popular expansion devices.
- describe how the three expansion devices respond to load changes.
- describe the operation of a balanced-port expansion valve.
- describe the operation of a dual-port expansion valve.
- describe how electronic expansion valves and their controllers operate.
- explain the operation and operating charge of a system incorporating a capillary tube metering device

Chapter 1: EXPANSION DEVICES

The expansion device,often called the metering device,is the fourth component necessary for the compression refrigeration cycle to function. The expansion device is not as visible as the evaporator, the condenser, or the compressor.



Chapter 1: EXPANSION DEVICES

The expansion device is one component that divides the high side of the system from the low side (the compressor is the other).

Figure shows its location. It is responsible for metering the correct amount of refrigerant to the evaporator.

The evaporator performs best when it is as full of liquid refrigerant as possible with none left in the suction line. Liquid refrigerant that enters the suction line may reach the compressor because only a small amount of heat is added in the suction line.

The expansion device is normally installed in the liquid line between the condenser and the evaporator. On a hot day, the liquid line may be warm to the touch and thus can be followed quite easily to the expansion device, where there is a pressure drop and an accompanying temperature drop.

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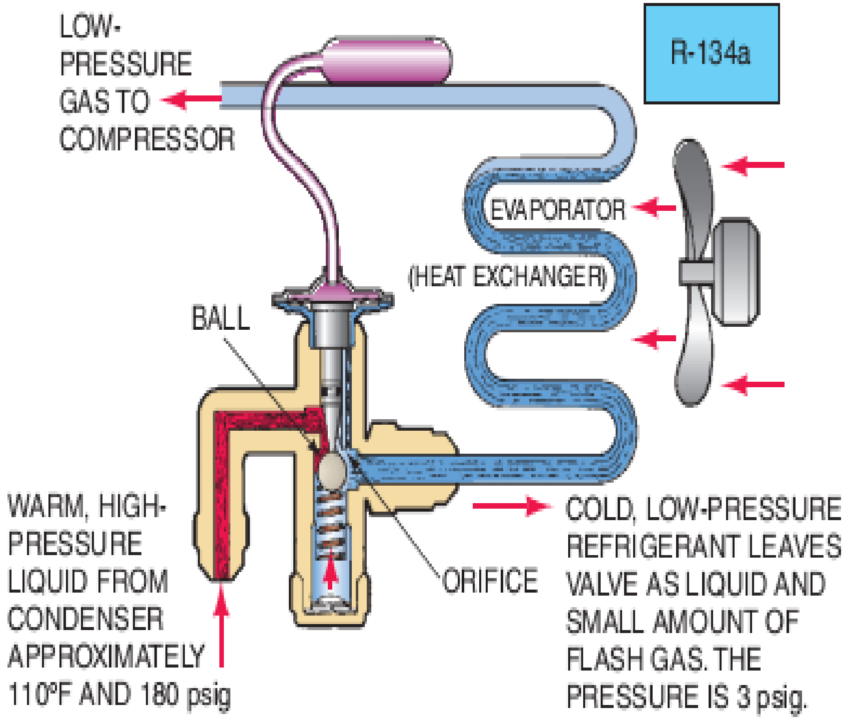
THERMOSTATIC EXPANSION VALVE



Chapter 1: EXPANSION DEVICES

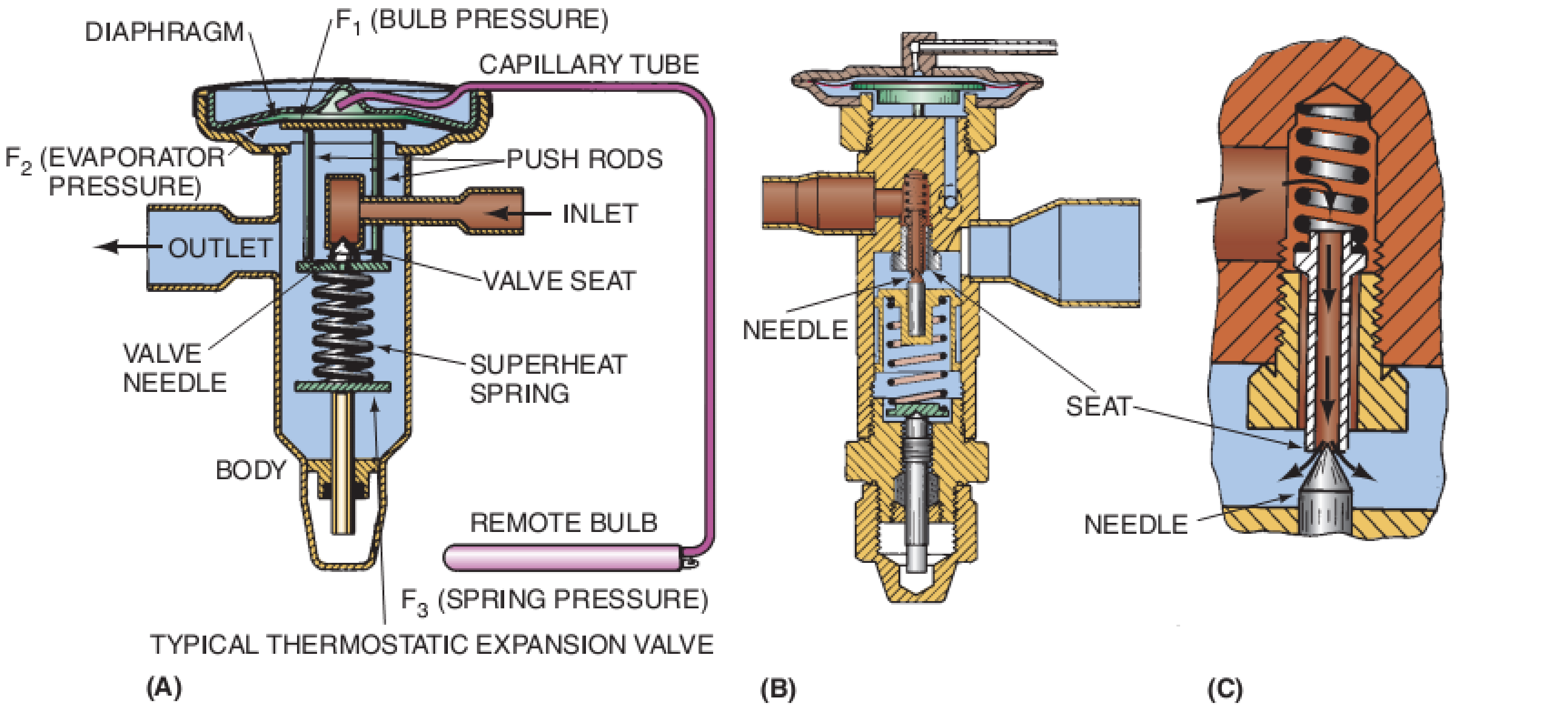
Expansion devices can be one of the following different types: (A) thermostatic expansion valve, (B) automatic expansion valve, and (C) fixed bore, such as the capillary tube

(A)

(B)

(C)

Chapter 1: EXPANSION DEVICES



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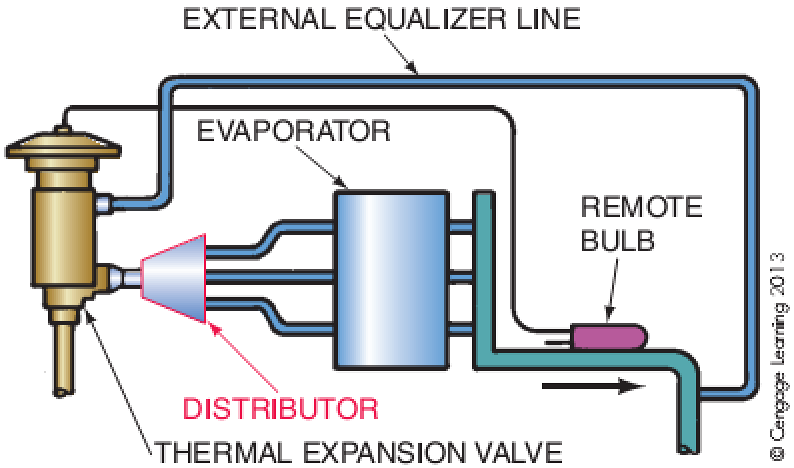
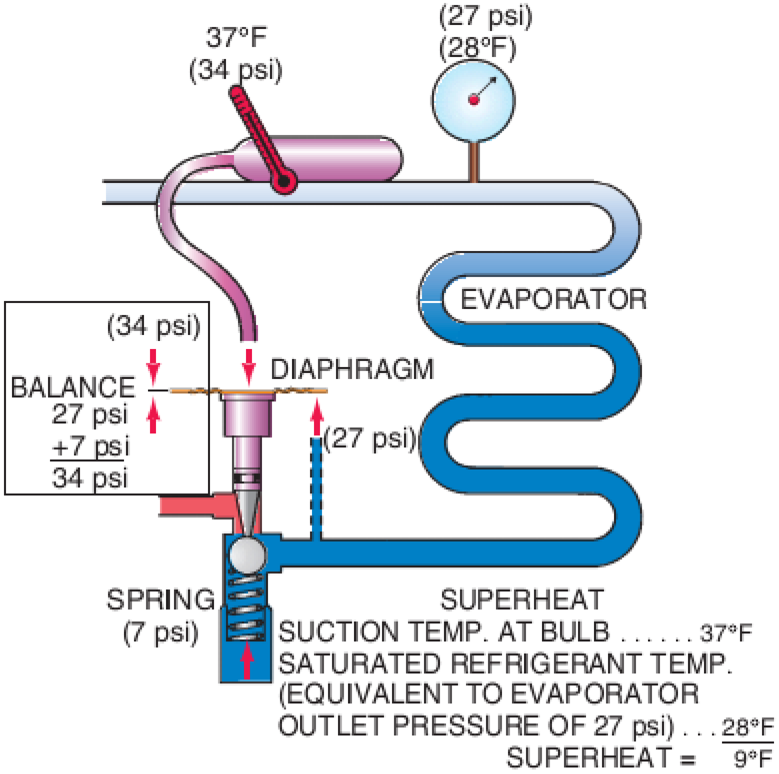
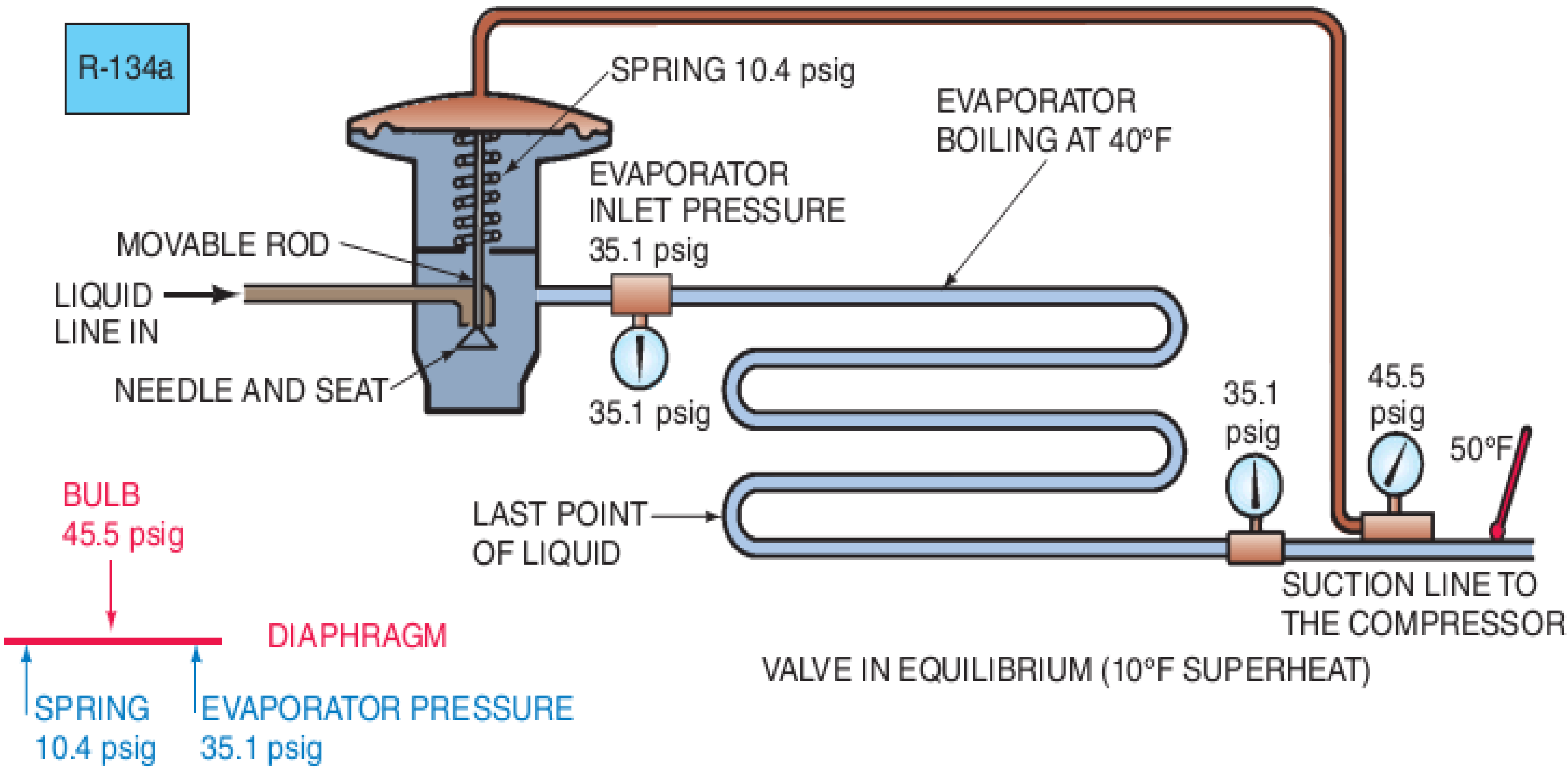




Chapter 1: EXPANSION DEVICES



(A) THE OPENING PRESSURE IS EQUAL TO THE SUM OF THE CLOSING PRESSURES.

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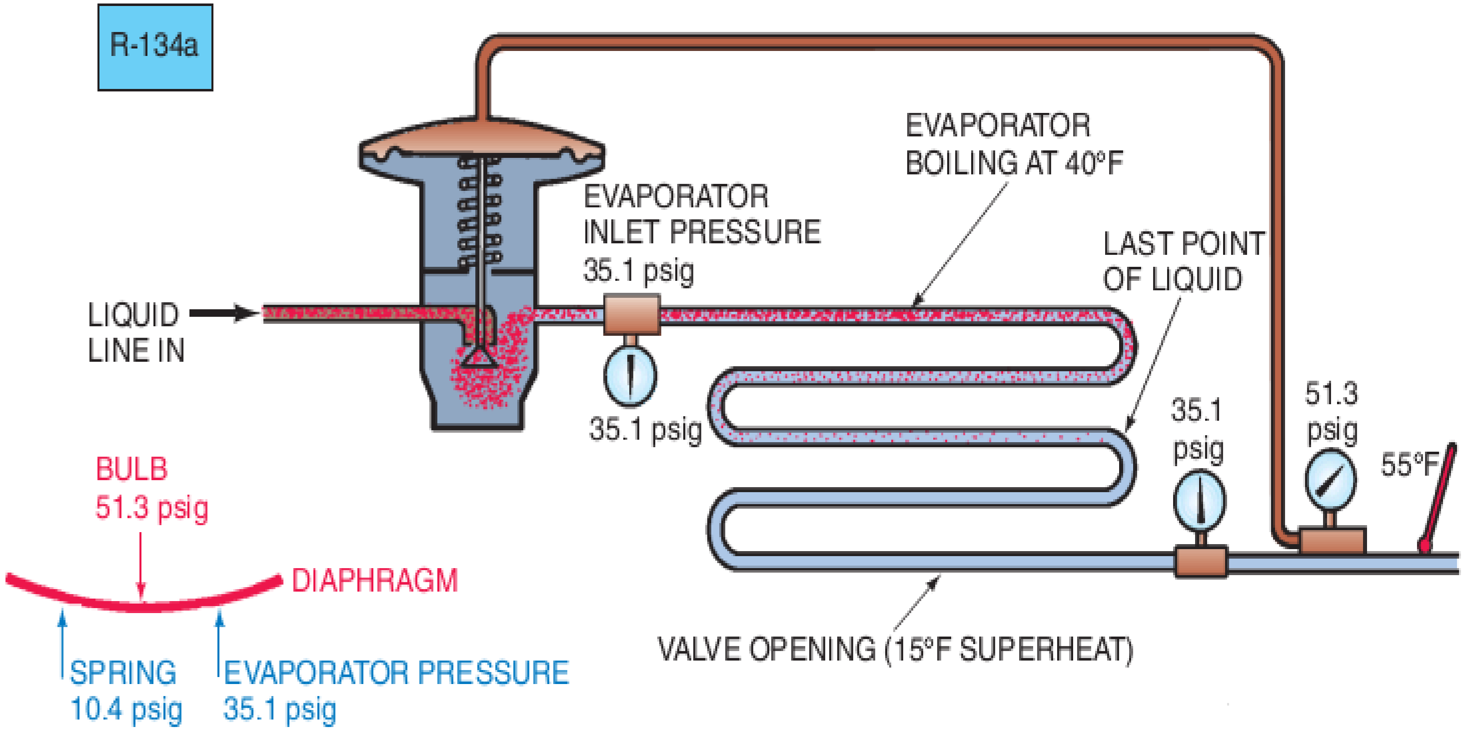

(B) THE OPENING PRESSURE IS GREATER THAN THE SUM OF THE CLOSING PRESSURES.

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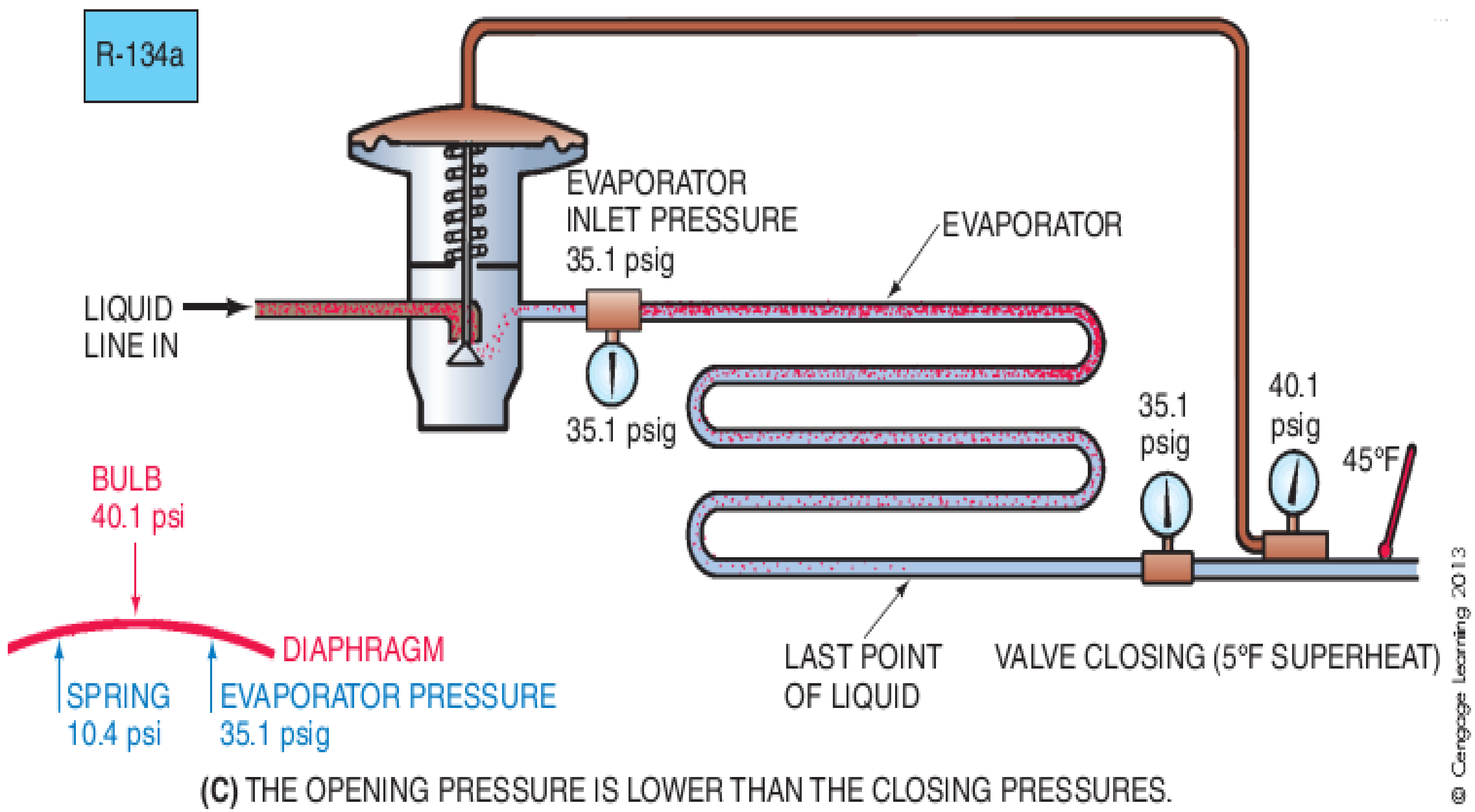

(C) THE OPENING PRESSURE IS LOWER THAN THE CLOSING PRESSURES.

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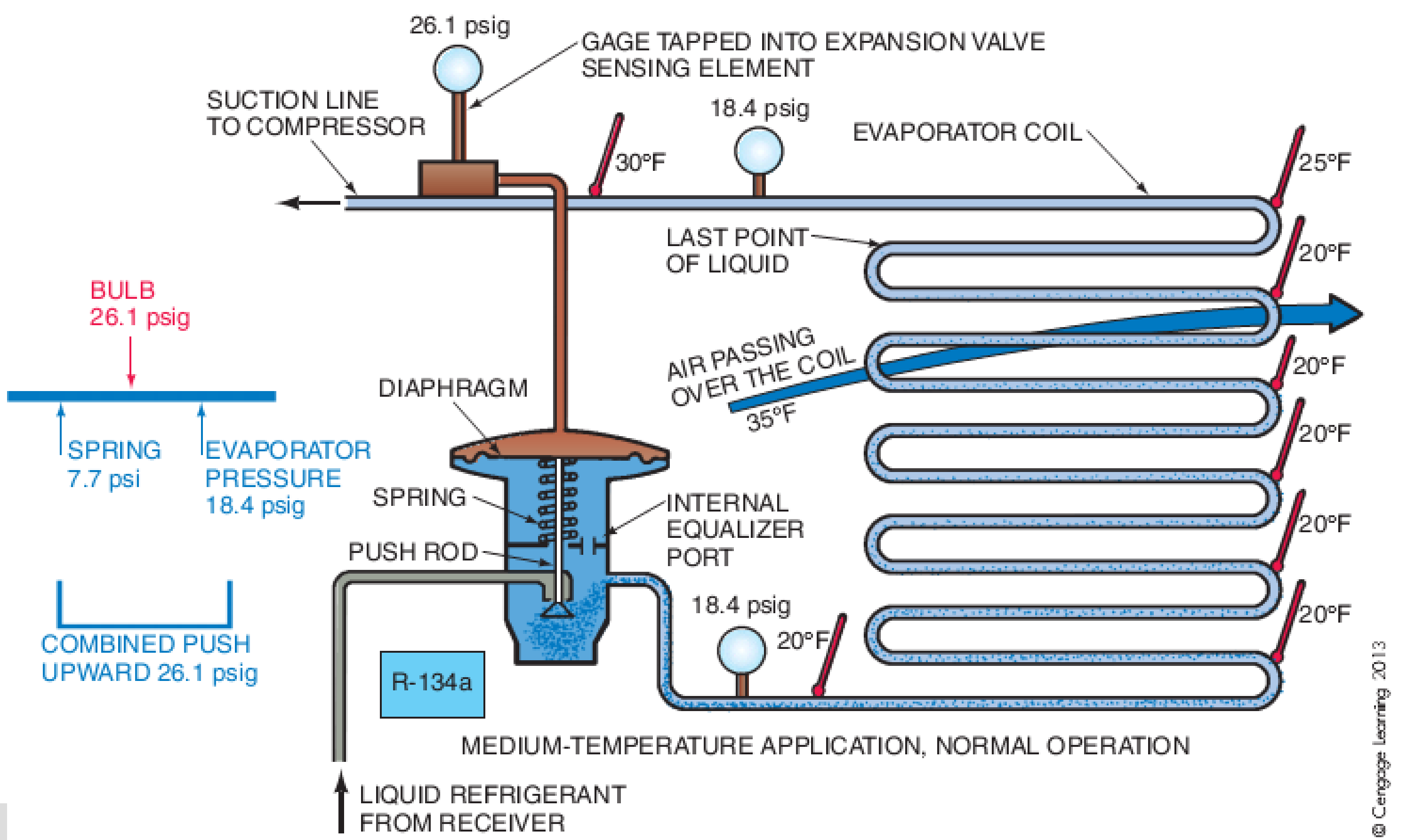
Chapter 1: EXPANSION DEVICES



Chapter 1: EXPANSION DEVICES

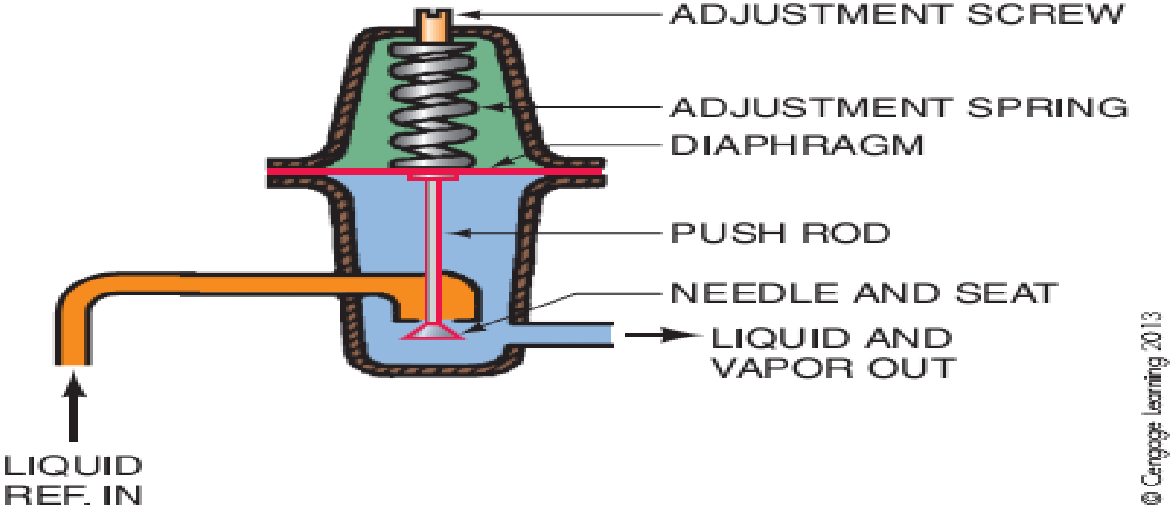
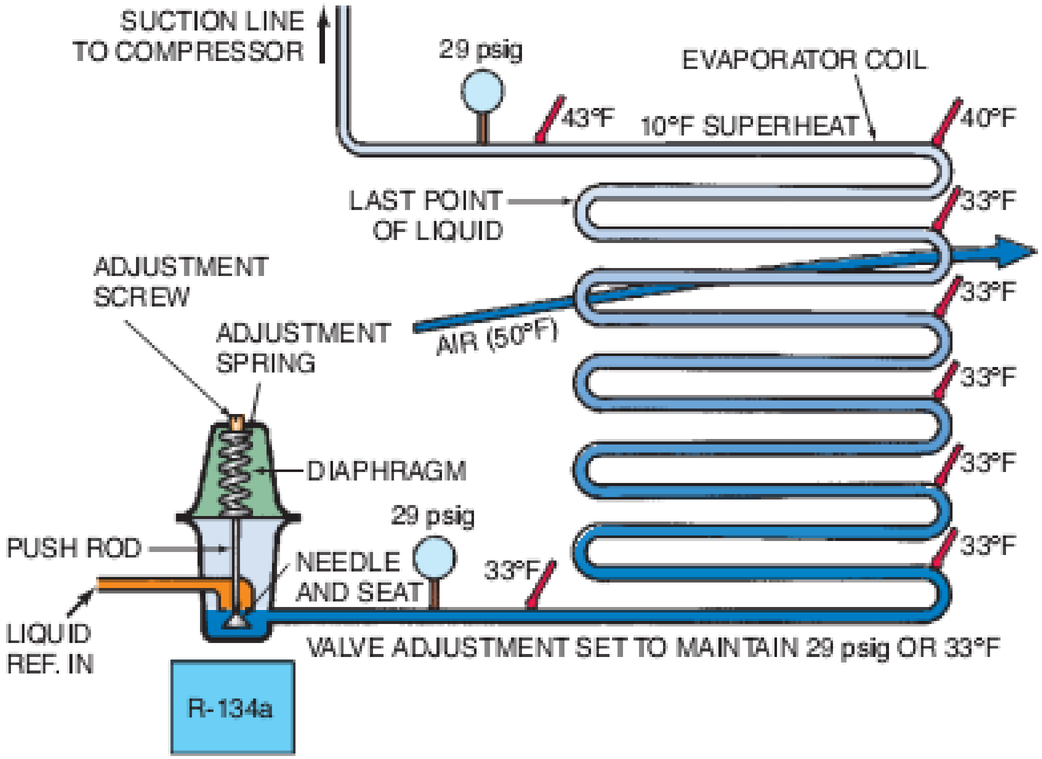


Figure 24.45 The automatic expansion valve uses the diaphragm as the sensing element and maintains a constant pressure in the evaporator but does not control superheat.

The automatic expansion valve (AXV)is an expansion device that meters the refrigerant to the evaporator by using a pressure-sensing device. This device is also a valve that changes in inside dimension in response to its sensing element. The AXV maintains a constant pressure in the evaporator. Notice that superheat is not mentioned.

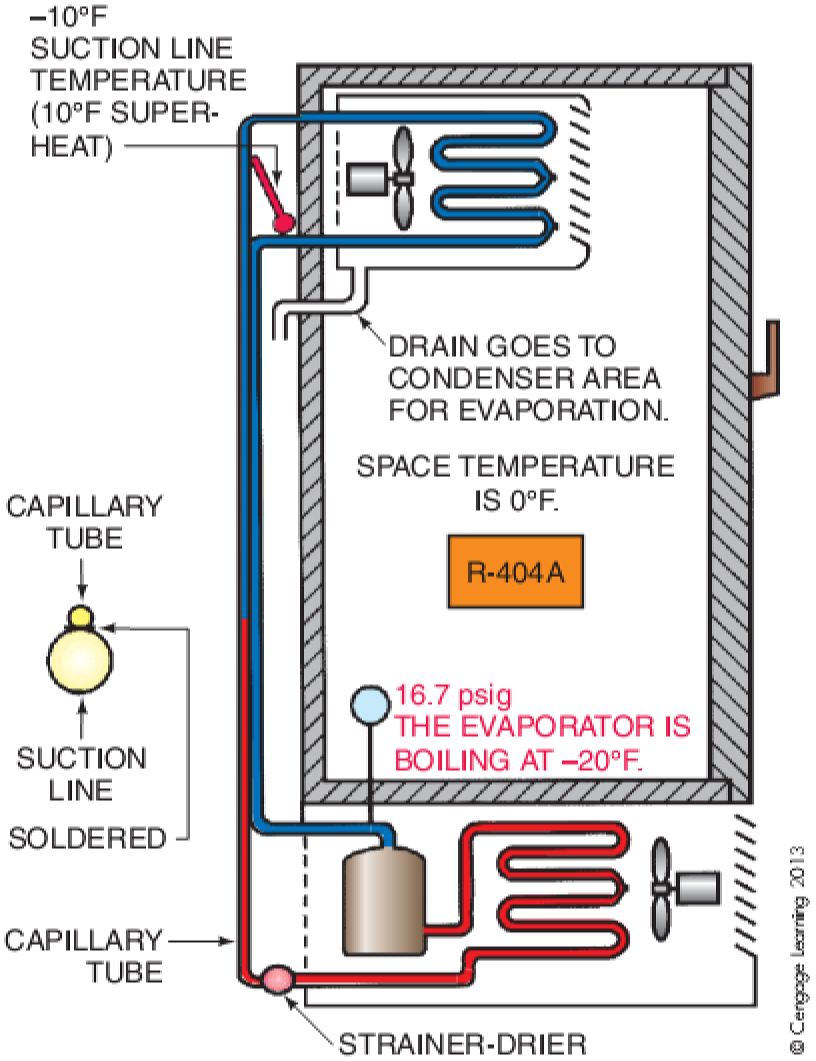
Chapter 1: EXPANSION DEVICES



(A)

Chapter 1: EXPANSION DEVICES

The capillary tube system requires only a small amount of refrigerant because it does not modulate (feed more or less) refrigerant according to the load



Chapter 1: EXPANSION DEVICES

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Thank You !